| 招 生 學 年 度 | 102 | 招 生 類 別 | 碩士班 |
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| 系 所 班 別 | 材料科學與工程學系碩士班 | | |
| 科　　　　目 | 冶金熱力學 | | |
| 注 意 事 項 | 本考科可使用掌上型計算機 | | |

單選題 ( 25 x 4% = 100 % )

1. Which of the following is not a state function?

　　(1) PV work　　(2) entropy　　(3) angular moment　　(4) internal energy　　(5) temperature

2. For the change of standard state $V_{(s)} = V_{(1\ wt\%\ in\ Fe)}$. $\Delta G^0 = -15480 - 45.61T$ J. The value of $\gamma_v^o$ at 1600°C is

_____.

　　(1) 0.0014　　(2) 0.014　　(3) 0.14　　(4) 1.4　　(5)　14.

3. The EMF of the cell $Ag_{(s)} \mid AgCl_{(s)} \mid Cl_{2(g,1\,atm)}, Pt$ is found to be

$\varepsilon(volts) = 0.977 + 5.7 \times 10^{-4}(350 - t) - 4.8 \times 10^{-7}(350 - t)^2$ in the temperature range t = 100°C to t = 450°C.
The value of $\Delta Cp$ for the cell reaction is _____ J K$^{-1}$mole$^{-1}$.

　　(1) 0.145　　(2) -2.361　　(3) 63.25　　(4) 1.562　　(5)　-0.093.

4. For an ideal gas, $PV^\gamma$=210.3, where $\gamma=c_p/c_v$. After a reversible adiabatic process, the pressure of system reduces from 20 atm to 4 atm. The work is _____ L atm.

　　(1) 28.6　　(2) 37.1　　(3) 49.5　　(4) 58.5　　(5)　68.9.

5. $C_p - C_V =$ _____

(1) $\left(\frac{\partial S}{\partial T}\right)_P \left[T\left(\frac{\partial S}{\partial V}\right)_T\right]$　　(2) $\left(\frac{\partial V}{\partial T}\right)_P \left[T\left(\frac{\partial S}{\partial V}\right)_T\right]$　　(3) $\left(\frac{\partial V}{\partial T}\right)_P \left[T\left(\frac{\partial P}{\partial V}\right)_T\right]$　　(4) $\left(\frac{\partial H}{\partial T}\right)_P \left[T\left(\frac{\partial S}{\partial V}\right)_T\right]$　　(5) $\left(\frac{\partial V}{\partial T}\right)_P \left[T\left(\frac{\partial A}{\partial V}\right)_T\right]$

6. Oxygen gas stored at a pressure of 200 atm at 300 K in a cylindrical vessel of diameter 0.2 meters and height 2 meters. The van der Waals constant for oxygen are a = 1.36 L$^2$atm/mole and b = 0.0318 L/mole. The mole of oxygen gas in a cylinder vessel is _____ moles.

　　(1) 565　　(2) 353　　(3) 232　　(4) 141　　(5)　102.

7. One mole of N$_2$ gas is contained at 273 K and a pressure of 1 atm. The addition of 3000 joules of heat to the gas at constant pressure causes 832 joules of work to be done during the expansion. C$_v$ of N$_2$ gas is _____ J mol$^{-1}$ K$^{-1}$.

　　(1) 0.0217　　(2) 0.217　　(3) 2.17　　(4) 21.7　　(5)　217.

8. A silver-gold alloy is a random mixture of gold and silver atoms. The gram atomic weights of Au and Ag are 198 and 107.6, respectively. When 10 g of gold are mixed with 20 g of silver to form a homogeneous alloy, the increase in entropy is _____ J/K

　　(1) -16.8　　(2) -8.34　　(3) 1.02　　(4) 9.20　　(5) 13.6.

9. A CO$_2$-CO-H$_2$O-H$_2$ gas mixture at a total pressure of 1 atm exerts a partial pressure of oxygen of 10$^{-7}$ atm at 1600°C. The Gibbs free energy of reaction $CO_2 + H_2 \rightarrow H_2O + CO$ at 1600°C is -142982 J. The ratio of CO$_2$/H$_2$ is _____.

　　(1) 0.1276　　(2) 1.276　　(3) 12.76　　(4) 127.6　　(5)　1276.

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10. The activity coefficient of Zn in liquid Zn-Cd alloys at 435°C can be represented as $\ln \gamma_{Zn} = 0.875 X_{Cd}^2 - 0.30 X_{Cd}^3$. The activity of cadmium in the alloy of $X_{Cd}$=0.5 at 435°C is _____.

(1) 0.247　(2) 0.398　(3) 0.452　(4) 0.577　(5) 0.699.

11. Copper exists in the state T = 298 K, P = 1atm. The molar volume of copper at 298 K is 7.09 cm³ and the thermal expansivity is 0.493 x 10⁻³ K⁻¹ in the range 1-1000 atm. The entropy increasement by increasing its pressure to 1000 atm at 298 K is equal to that at 1 atm by increasing its temperature to _____ K.

(1) 327　(2) 458　(3) 589　(4) 1027　(5) 3012.

12. The normal boiling temperature of iron is 3330 K. The rate of change of the vapor pressure of liquid iron with temperature is 3.72 x 10⁻³ atm/K. The molar latent heat of boiling of iron at 3330 K is _____ J.

(1) 3423764　(2) 342376.4　(3) 34237.64　(4) 3423.764　(5) 342.3764.

13. The constant pressure molar heat capacity of SiC varies with temperature as $C_P = 50.79 + 1.97 \times 10^{-3} T - 4.92 \times 10^6 T^{-2} + 8.2 \times 10^8 T^{-3}$ J mol⁻¹ K⁻¹. When 1 molar of SiC is heat from 25°C to 1000°C, the change of entropy is _____ J/K.

(1) 5970　(2) 597　(3) 59.7　(4) 5.97　(5) 0.597.

14. The molar volumes of solid and liquid lead at the normal melting temperature of lead are respectively, 18.92 cm³ and 19.47 cm³. The melting enthalpy is 4810 J. In order to increase its melting temperature 20°C, lead must be applied _____ atm.

(1) 2　(2) 28　(3) 282　(4) 2822　(5) 28223.

15. The vapor pressure of solid $CO_2$ is given as $\ln p(atm) = -\dfrac{3116}{T} + 16.01$. The triplet point is -56.2°C. The molar latent heat of melting of $CO_2$ is 8330 joules. The vapor pressure exerted by liquid $CO_2$ at 25 °C is _____ atm.

(1) 93.3　(2) 73.3　(3) 53.3　(4) 33.3　(5) 13.3.

16. Gas constant is NOT

(1) 8.314 J K⁻¹ mol⁻¹　　(2) 3.14　　(3) 5.19×10¹⁹ eV K⁻¹ mol⁻¹
(4) 1.987 cal K⁻¹ mol⁻¹　　(5) 0.082 L atm K⁻¹ mol⁻¹.

17. The partial pressure of oxygen in equilibrium with pure liquid lead and pure liquid lead oxide at 1200 K is 2.16x10⁻⁹ atm. When $SiO_2$ is added to the liquid PbO to form a lead silicate melt the oxygen pressure in equilibrium with pure liquid lead and the silicate melt is decreases to 5.41x10⁻¹⁰ atm. The activity of PbO in the lead silicate melt is _____.

(1) 0.3　(2) 0.4　(3) 0.5　(4) 0.6　(5) 0.7.

18. A reversible heat engine, operating in a cycle, withdraws heat from a high temperature reservoir. The two reservoirs are, initially, at the temperatures $T_1$ and $T_2$ and have constant heat capacities $C_1$ and $C_2$, respectively. The finial temperature of the system is _____.

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(1) $\sqrt{(T_1 + T_2)}$　(2) $\frac{1}{2}(T_1 + T_2)$　(3) $(T_1^{c_1} + T_2^{c_2})^{\frac{1}{c_1+c_2}}$　(4) $(T_1^{c_1} T_2^{c_2})$　(5) $(T_1^{c_1} T_2^{c_2})^{\frac{1}{c_1+c_2}}$.

19. For $2Ni_{(s)} + O_2 = 2NiO$, $\Delta G^0 = -471200 + 172T$ J. For $2NiO = 2Ni_{(l)} + O_2$, $\Delta G^0 = 506180 - 192.2T$ J. The molar entropy of melting of nickel is _____ J/K.

(1) 0　(2) 10.1　(3) 23.5　(4) 37.1　(5) 47.5.

20. $4MgO_{(s)} + Si_{(s)} = 2Mg_{(g)} + Mg_2SiO_4$, the molar reaction Gibbs free energy at 1400°C is 183474 J. The vapor pressure of Mg exerted at 1400°C by the system is _____ atm.

(1) $2.42 \times 10^{-8}$　(2) $2.42 \times 10^{-6}$　(3) $2.42 \times 10^{-4}$　(4) $2.42 \times 10^{-2}$　(5) 2.42 .

21. For a real gas P(V-b)=RT, $C_p - C_v =$
(1) R　(2) bR　(3) $R/b^2$　(4) R/b　(5) None is correct.

22. $\left(\frac{\partial T}{\partial V}\right)_S = $ _____　(1) $-\left(\frac{\partial S}{\partial P}\right)_V$　(2) $-\left(\frac{\partial P}{\partial S}\right)_V$　(3) $\left(\frac{\partial P}{\partial S}\right)_V$　(4) $-\left(\frac{\partial P}{\partial S}\right)_T$　(5) $\left(\frac{\partial S}{\partial P}\right)_V$.

23. The solid Cu-Au system is virtually regular in its solution behavior, with a molar Gibbs excess free energy of mixing given by $G^{XS} = -28280 X_{Au} X_{Cu}$ J at 600°C. When $X_{Cu} = 0.5$ at 600°C, the activity of Cu is _____.

(1) 0.0888　(2) 0.1888　(3) 0.2888　(4) 0.3888　(5) 0.4888.

24. Spectroscopic observation of molecular $N_2$ in an electrical discharge shows that the relative numbers of molecules an excited vibrational states with energies given by $\varepsilon_i = \left(i + \frac{1}{2}\right) h\nu$, where $i$ is an integer value in the range zero to infinity, $h$ is Planck's constant of action ($6.6252 \times 10^{-34}$ J s), and $\nu$ is the vibration frequency ($7.00 \times 10^{13}$ s$^{-1}$). When $i$ are 0, 1, 2, and 3, $n_i/n = 1.00, 0.250, 0.062$, and 0.016, respectively. The temperature of the gas is _____ K.

(1) 151　(2) 302　(3) 605　(4) 1210　(5) 2420.

25. According to IUPAC convention, the expression of work w, if negative for a system in adiabatic enclosure, implies all of the following, except.
(1) The internal energy of the system has changed (2) work has been done by the system (3) the internal energy of the universe is the same (4) the entropy change of system is zero, (5) a negative mount of work has been done on the system.